

VIII. Sources Of Water Pollution

The predominant sources of impairment in streams and rivers are agricultural activities and hydromodification (channelization, dams, and dredging). Additional streams are impacted by municipal discharges, runoff, urban development, and mining impacts as well as many other impacts. The major source of impacts to reservoirs is contaminated sediment. Table 8 provides a detailed break down of the various sources of pollution in Tennessee's streams, rivers, and reservoirs.

A. Relative Sources Of Impacts to Rivers and Streams

Some impacts, like point source discharges and urban runoff, are evenly distributed across the state. Other pollutants are concentrated in certain areas of the state. For instance, channelization and crop related agriculture is most widespread in west Tennessee. Dairy farming and other intensive livestock operations are concentrated in the Ridge and Valley region of east Tennessee and in southern Middle Tennessee.

An emerging threat in middle Tennessee is very rapid commercial and residential development in Nashville and other urban areas. Mining continues to negatively impact streams in the Cumberland Plateau and Central Appalachian regions. Figure 13 illustrates the percent contribution of pollution sources in assessed rivers and streams.

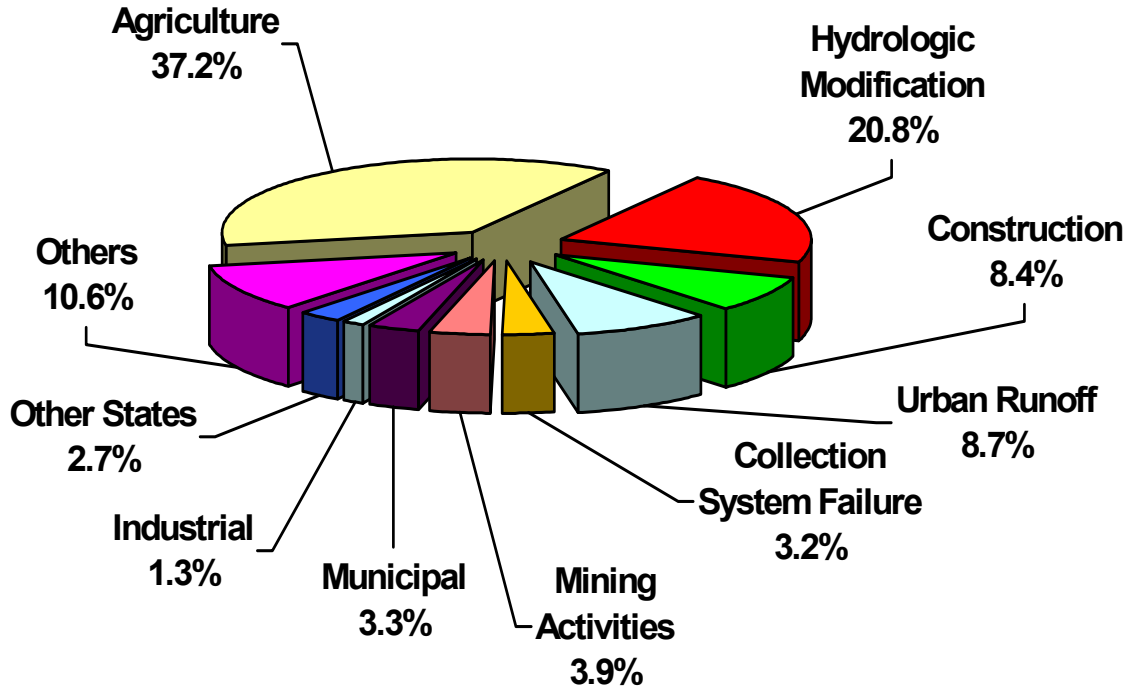


Figure 13: Percent Contribution of Pollution Sources in Assessed Rivers and Streams.

Table 8: Sources of Pollutants in Rivers and Reservoirs*

Sources Category	Total Impacted River Miles	Total Impacted Reservoir Acres
Industry		
Unspecified Industry	65.0	1000
Major Industry	96.7	
Minor Industry	14.9	
Municipal		
Major Municipal Point Source	224.3	994
Minor Municipal Point Source	265.1	
Package Plants	2.9	
Combined Sewer Overflows	9.8	994
Collection System Failure	452.1	10
Agriculture		
Agriculture (unspecified)	1118.9	595
Crop related sources	1237.8	15,500
Grazing related sources	2696.0	11
Intensive Animal Feeding Operations	117.2	34
Silviculture	14.9	
Resource Extraction		
Unspecified Resource Extraction	101.4	494
Surface Mining	28.2	
Abandoned Mining	366.4	480
Inactive Mining	18.7	
Petroleum activities	17.9	
Mill Tailings	5.0	
Mine Tailings	8.5	
Urban Sources		
Unspecified Urban Runoff/Storm Sewers	1154.7	1,054
Non-industrial Permitted Stormwater	8.4	
Industrial Permitted Stormwater	38.7	
Illicit Connections	6.5	
Hwy. /Road/Bridge Runoff	32.8	

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Table 8: Sources of Pollutants in Rivers and Reservoirs (Continued)

Sources Category	Total Impacted River Miles	Total Impacted Reservoir Acres
Hydromodification		
Unspecified	306.7	5
Channelization	2051.9	
Dredging	258.3	
Upstream Impoundment	275.1	494
Flow Regulation/Modification		2900**
Construction		
Unspecified Road or Bridge Construction	55.3	10,965**
Land Development	1099.3	10,965**
Habitat Modification		
Unspecified Habitat Modification	47.9	
Bank or Shoreline Modification	96.5	
Riparian Vegetation Removal	295.8	
Drainage/Filling Wetland		10,950**
Land Disposal		
Sludge	3.1	
Landfills	57.9	
Hazardous Waste	118.2	
Septic Tanks	150.4	
Other Sources		
Internal Nutrient Cycling		15,500**
Sources in Other States	313.7	383
Spills	10.3	
Golf Courses	0.5	
Groundwater Loading	1.1	
Waste Storage Tanks Leaks	4.3	
Leaking Underground Storage Tanks	8.9	
Hwy. Maintenance and Runoff	31.0	
Sources Unknown	479.5	

*Rivers and reservoirs can be impacted by more than one source of pollutants. Data in this table should only be used to indicate relative contributions. Totals are not additive.

** Majority of impairment sources in these categories are in Reelfoot Lake.

1. Agriculture

Almost half of the land in Tennessee is used for agriculture, so it is not surprising that these activities are responsible for approximately 37 percent of the impaired stream miles in the state. In west Tennessee tons of soil are lost annually due to erosion. In middle Tennessee, livestock grazing is the major agricultural activity. Intensive hog farming is widespread in the southern middle portion of the state and in West Tennessee. In East Tennessee runoff from feedlots and dairy farms greatly impact some streams. Throughout the state, in-stream watering of livestock is a significant source of fecal coliform bacteria, especially in the summertime. Figure 14 illustrates the relative percentage of the primary agricultural impairment sources.



In areas like the Sequatchie Valley, intensive grazing and direct access of cattle to streams causes habitat impacts and elevated pathogen levels, both major causes of pollution. (Photo by Terry Whalen, Chattanooga EAC)

The Tennessee Water Quality Control Act does not give the Division authority to regulate nonpoint pollution originating from normal agricultural activities such as plowing fields, tending animals and crops, and cutting trees. However, the agricultural activities that may result in a significant point source pollution, such as failing animal waste system discharges, are regulated.

Tennessee agriculture has made great strides in recent years to prevent agricultural and forestry impacts. Educational and cost-sharing projects promoted by NRCS and UT Agricultural Extension Service has helped farmers install best management practices all over the state. Farmers have also helped to decrease erosion rates and thereby protect streams by increasing riparian habitat zones and setting aside substantial amounts of acreage as conservation reserves.

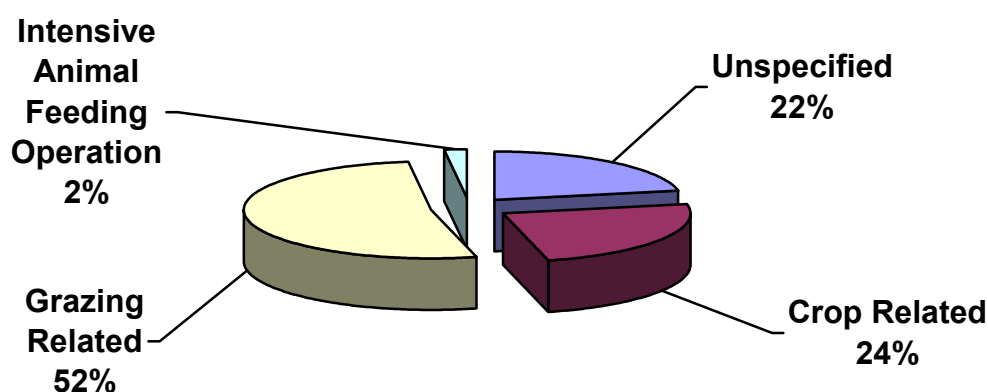


Figure 14: Sources of Agricultural Pollution in Assessed Rivers and Streams

The Division has a Memorandum of Understanding with the Tennessee Department of Agriculture (TDA). Under this agreement, the Division and TDA will continue to resolve complaints about water pollution from agricultural activities. When a problem is found or a complaint has been filed, TDA has the responsibility to contact the farmer or logger. Technical assistance is offered to correct the problem. If these efforts are unsuccessful, the TDA will be supportive of the Division's more formal enforcement process. TDEC and TDA coordinate on water quality monitoring, assessment, 303(d) list development, TMDL generation, and control strategy implementation.

2. Hydrologic Modifications

Hydrologic modification (altering the physical properties of streams) is a source of impairment in over 20 percent of the assessed streams in Tennessee. Hydrologic modifications include channelization (straightening streams), culverting (burying streams), stream lining, or impoundments (damming streams for the construction of a pond or reservoir).

Physical alteration of streams can only be done as authorized by the state. Permits to alter streams are called Aquatic Resource Alteration Permits (ARAPs). Failure to obtain a permit before modifying a stream can lead to enforcement actions that require restoration of the stream.

a. Culverting

Many streams, especially those located in cities, have been totally enclosed by culverts. In the most extreme cases, buildings or shopping centers have been built on top of streams. These waters are no longer available for public recreation and aquatic life cannot survive. Many of these culverts were installed before the Division had regulatory authority over physical alteration of streams. Now an Aquatic Resources Alteration Permit must be obtained to install a culvert. Generally speaking, a bridge or even relocation of a stream is preferred over installing a culvert. Compensatory mitigation may be required for larger projects where culverting is unavoidable.



In some of the urbanized areas of Tennessee, streams were historically lined with concrete. While this practice helped develop areas prone to flooding, it had a devastating affect on water quality. Streams such as the one pictured above in Memphis, have very little chance to meet water quality goals. (Photo by Terry Templeton, Memphis EAC)

b. Stream impoundment

Problems associated with the impoundment of streams are increasing as more free flowing streams are dammed on both a large and small scale. It has been the experience of the Division that very few of these impoundments can be managed in such a way as to avoid water quality problems.

Problems often associated with stream impoundment include:

- Erosion during dam construction.
- Loss of stream for recreational use.
- Change in the water flow downstream of the dam.
- Elevated metals downstream of the dam.
- Low dissolved oxygen levels in tailwaters decrease biological diversity downstream and threatens species with special status.
- Habitat change results in loss of stream organisms.
- Barriers to fish migration.

c. Channelization

Many rivers and streams in Tennessee have been straightened or channelized. Originally, channelization was implemented to control flooding and protect croplands along the river. Additionally, especially in West Tennessee, channelization was used extensively to drain wetlands so more land may be used for crops.



Channelization continues to be a major source of impacts, especially in West Tennessee. The stream pictured above has already begun the process of “downcutting” as the channel seeks to regain its stability. (Photo by Amy Fritz, Jackson EAC)

Some of the costs associated with channelization or decreasing stream meanders include:

1. Increases erosion rates and soil loss.
2. Eliminates valuable fish and wildlife habitat by draining wetlands and clearing riparian areas.
3. Kills bottomland hardwoods.
4. Transfers flooding problems downstream.
5. Causes “downcutting” of stream bed as the channel tries to regain stability.

In recent years, no large-scale channelization projects have been approved. Tennessee is working with the Corps of Engineers to explore methods to reverse some of the historical damage to water quality caused by channelization. Some streams continue to be channelized by landowners.

3. Urban Runoff

As storm water drains through urban areas it picks up pollutants from yards, streets, and parking lots and deposits them into streams. This non-specific runoff can be laden with silt, bacteria, metals, and nutrients. Following heavy rains, streams have been noted as having various pollutants at elevated levels for several days. Water quality standards violations have been documented downstream of all four of Tennessee’s large cities: Memphis, Nashville, Chattanooga, and Knoxville, plus many other smaller towns.

Traditionally, urban runoff was considered a non-point source (from a generalized rather than specific pollution source). However, the regulation of storm water runoff falls under the federal NPDES program. Industries and large commercial operations such as junkyards and construction sites are required to operate under storm water discharge permits. These permits require mandatory installation of pollution controls.

Memphis, Nashville, Chattanooga, and Knoxville are now covered by the Tennessee Municipal Separate Storm Sewer System (MS4) permit. Under this permit, these cities develop their own storm water programs and do the direct regulation of sources at a local level. Construction sites over five acres have to apply for coverage under the general construction permit. (The acreage covered by this regulation will soon change to include sites over one acre.)

Phase II of the MS4 program will expand to include many smaller cities and counties in Tennessee. Those areas having a population greater than 10,000, or having streams assessed as impacted due to urban runoff, must also develop storm water programs.

4. Construction

The populations of many Tennessee communities have rapidly expanded in the last decade. The construction of subdivisions, shopping malls, and highways can harm the water quality if the sites are not properly stabilized. The impacts most frequently associated with land development are siltation and habitat alteration.

Storm water control programs and regulations on a local level have been helpful in controlling water quality impacts from land development. Memphis, Nashville, Chattanooga, and Knoxville already have storm water control programs in effect. Some of our next level towns like Jackson, Clarksville, Murfreesboro, Columbia, Johnson City, Kingsport and Bristol are currently developing storm water programs. Local staff will help identify sources of storm water runoff and help develop control strategies.



*At this site, a stream was being physically altered without proper authorization from the state.
(Photo provided by Wayne Blaylock, Enforcement.)*

5. Mining Activities

In the 1970's coal mining was one of the largest pollution sources in the state. "Wildcat" operators strip-mined land without permits or regard for environmental consequences, to provide low-priced coal to the growing electric industry. When they got all the readily available coal, they would abandon the site. In 1983, the price for coal bottomed out, so it was no longer profitable to run "wildcat" mining operations.

Although many streams are still impacted by silt, pH, manganese, and iron, considerable progress has been made at site reclamation. Abandoned strip mines are slowly being reclaimed under the Abandoned Mine Reclamation program and some are naturally revegetating. New mining sites are required to provide treatment of runoff.

6. Industrial and Municipal Discharges

Although industrial pollution is lower than it was a few decades ago, industrial and municipal facilities continue to impact some streams and reservoirs in Tennessee. A major municipal source of pollution is the overflow or bypass of sewage treatment systems. Industrial impacts include occasional spills, temperature alterations, and historical discharge of long-lived materials that get concentrated in the food chain. Occasionally, both sewage treatment systems and industrial dischargers fail to meet permit requirements.

7. Collection System Failure

Municipal sewage treatment plants have permits designed to prevent impacts to the receiving stream. Unfortunately, the collection systems of some sewage treatment plants occasionally malfunction, or become overloaded, which can result in the discharge of high volumes of untreated sewage to a stream. If a large amount of untreated sewage enters a stream or river it can devastate aquatic life and pose a serious health threat to people who come in contact with the water. A serious concern near urban areas is children who may play in streams after rain events and be exposed to elevated bacteria levels.

Permits contain provisions which require that “bypasses” be reported. Collection systems must constantly be monitored by cities to insure that they are not leaking. At times, enforcement action must be taken against cities that fail to report and correct system bypasses.

8. Silviculture

Silviculture, tree farming, or other forestry activities impact relatively few stream miles compared to other sources. However logging, without proper controls, has impacted some small headwater streams throughout the state. In 2000, the Department took enforcement actions for water quality violations by forestry operations in various parts of the state. In conjunction with TDA, the Department has authority to issue a “stop work order” when logging is taking place improperly and pollution results.

B. Distribution of Impacts to Reservoirs

Like streams, reservoirs are impacted by many sources of pollution (Table 8). However, the dominant pollutant impacting reservoirs is sediment contaminated by toxic organic substances. The other significant impact is nutrient enrichment caused by agricultural activities and sewage treatment plant malfunctions. Figure 15 shows the percentage of various source impacts in reservoirs.

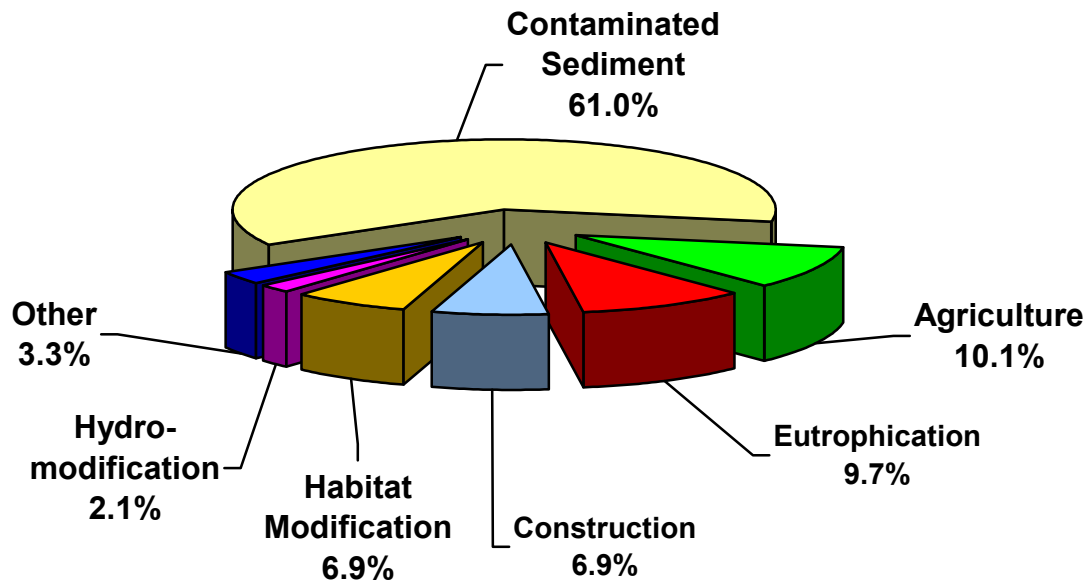


Figure 15: Percent Contribution of Pollution Sources in Assessed Reservoirs. (Includes Reelfoot Lake.)

1. Contaminated Sediments

A major problem in reservoirs is the concentration of organic pollutants in fish tissue. In most places in Tennessee it is safe to eat the fish. In some reservoirs organic pollutants, primarily PCBs, dioxins, chlordane and other pesticides in the sediment, are concentrated in the fish. Since reservoirs function as sediment traps, they are prone to sediment contamination.

The Department of Environment and Conservation is required by law to post contaminated waterbodies and advise the public of health risks from consuming contaminated fish. The Tennessee Valley Authority (TVA) and the Tennessee Wildlife Resources Agency (TWRA) share resources and expertise in this process.

Fish tissue samples are collected and analyzed across the state. The results of these analyses are compared to the criteria developed by FDA and EPA. If fish tissue is found to be contaminated and the public's ability to safely consume fish is impaired, the lake is appropriately posted and assessed as not supporting recreational uses.

EPA recently published a national list of lakes, reservoirs and streams that exceeded established sediment contamination screening values. Five Tennessee reservoirs including Fort Loudoun, Watts Bar, Chickamauga, Nickajack, and Kentucky, plus two rivers, the Hiwassee and Holston were on this list. However, it should be noted that the screening values used by EPA are not criteria. Additionally, there is little direct evidence that sediment contamination at those screening levels is clearly related to fish and aquatic life impacts.

Many pesticides like DDT, PCBs, and chlordane found in fish tissue today were widely distributed in the environment before they were banned. The levels of these substances will slowly decrease over time. Currently companies with permits to discharge organic substances have very restrictive limits.

2. Agriculture

As in streams and rivers, reservoirs are greatly impacted by agricultural activities. Plowing and fertilizing croplands can result in the runoff of tons of soil and fertilizers. Over 16,000 lake acres in Tennessee are listed as impaired by farming activities. However, a considerable portion of these acres are represented by Reelfoot Lake. Reelfoot is listed as impaired due to erosion from agricultural areas.

3. Reservoir Eutrophication

When a free flowing waterway is dammed, the aging process or eutrophication of the reservoir begins. Eutrophication is a natural process that can take hundreds of years to complete. However, the process can be greatly accelerated by human activities.

Eutrophication in a lake or reservoir is caused by a combination of several things:

- Sediment and soil from the watershed accumulates in the reservoir.
- Nutrients wash in and stimulate the growth of plants and algae. When the algae and plants die, they sink to the bottom and accelerate the filling process.
- Both algae growth and sediment in the water restricts the light penetration to a few feet or even a few inches. Robbed of sunlight and oxygen-producing photosynthesis, the lower level of the lake forms a cold, poorly oxygenated layer. Therefore, fish can only survive in the oxygenated surface waters. This layering of reservoirs is called stratification.

Eutrophication is a natural process that will proceed in any lake. It becomes pollution when it is accelerated by human activities, interferes with the desired uses of the lake, or when it causes water quality standards to be violated in the lake or receiving stream. For additional information on eutrophication see Chapter VII.

The eutrophication process is triggered by nutrients, usually nitrogen or phosphorus, entering a lake. Where eutrophication has caused pollution in reservoirs, nutrient loadings from the following sources are frequently cited:

- **Urban Runoff** - Heavy rains wash trash, dirt, lawn chemicals, street and parking lot residue, and other materials found in cities into our streams and reservoirs. This runoff usually contains elevated levels of nutrients.
- **Agricultural Activities** - The primary sources of nutrients from farmlands are soil erosion from cropland, overuse or improper application of fertilizers, and animal waste from livestock holding or feeding areas. Leaving buffer zones of trees and undergrowth around streams, fencing livestock away from streams, maintaining functional animal waste systems, and other proven best management practices help avoid these impacts.
- **Municipal Discharges** - Sewage treatment plants discharge levels of nutrients that may lead to downstream problems in reservoirs. To help reduce this problem, some states control the amount of phosphorus that can be contained in detergents and other laundry products. Therefore, commercially available laundry detergents no longer contain phosphorus. Additionally, some states have mandatory nutrient source reduction requirements in the watersheds of reservoirs that violate algal biomass criteria. In Tennessee, wastewater dischargers will be given permit limits if effluents are causing or contributing to the eutrophication of downstream waters.
- **Septic Tanks** - In properly functioning septic tanks, microorganisms in the soil and treatment system filter, remove, or absorb nutrients. On the other hand, faulty septic tanks, or poor soil types may allow untreated wastes to be discharged directly or indirectly into reservoirs.